SECTION III: STATE OF THE WATERSHED REPORT FOR SACRAMENTO RIVER WATERSHED

Watershed Description

The Sacramento River drains the northern part of the Central Valley. The Sacramento River's Basin covers 27,210 square miles. For planning purposes, this includes all watersheds tributary to the Sacramento River that are north of the Cosumnes River watershed, including the closed basin of Goose Lake, the drainage sub-basins of Cache and Putah Creeks and the Yolo and Sutter Bypasses.

The principal streams are the Sacramento River and its larger tributaries: the Pit, Feather, Yuba, Bear, and American Rivers to the east; and Cottonwood, Stony, Cache, and Putah Creeks to the west. Major reservoirs and lakes include Shasta, Oroville, and Folsom, Clear Lake, and Lake Berryessa. The remaining inputs (approximately 25% of the flow) come from streams entering from smaller watersheds along the river and from agricultural and storm drain systems (SWRCB 1990). The Sacramento River basin supplies more than 80% of the fresh water flows to the Sacramento-San Joaquin Delta (Montoya *et al*. 1988). There are over 50 sub-basins or tributaries to the Sacramento River.

DWR Bulletin 118-80 identifies 63 groundwater basins in the Sacramento River watershed area. The Sacramento Valley floor is divided into two groundwater basins.

There are separate State of the Watershed Reports for the Pit River, Feather River, and Cache Creek.

Water Quality Assessment, Strategies and Activities, and Resource Needs

SURFACE WATER

Beneficial uses in the Sacramento River watershed are adversely impacted by the presence of pollutants and sediments entering the watershed from a variety of sources. In 1990, the State Water Resources Control Board released the final project report for the *Sacramento River Toxic Chemical Risk Assessment Project*. In this report, the four major sources of chemical pollutants entering the Sacramento River were identified and characterized. These sources are agricultural drainage, mine drainage (primarily acid mine drainage), urban runoff, and NPDES discharges. Animal production facilities, rangelands and forest activities (including fires) were not included in that assessment, but should be considered to be potential sources of pollution. Since 1987, Regional Board staff has conducted a series of toxicity surveys of various portions of the Sacramento River watershed. Significant toxicity has been detected throughout the watershed. About half of the observed toxicity has been linked to specific pesticides, herbicides, and metals. In addition to these chemical constituents, the watershed is impacted by sedimentation, high temperatures, altered flow and temperature regimes, loss of habitat and introduction

of exotic species. High priority issues for the Sacramento River watershed are reducing the loads of organophosphate (OP) pesticides, mercury and other metals, and developing temperature objectives protective of salmonids. The load reduction studies are partially funded; however, the development of temperature objectives protective of salmonids is unfunded.

Organophosphate (OP) Pesticides

The Sacramento River and its tributaries have been included in the Clean Water Act 303(d) list as impaired due to elevated levels of diazinon causing toxicity to *Ceriodaphnia*. The source of the diazinon is from orchards and urban areas. There are no water quality objectives for diazinon; however, the Department of Fish and Game has developed criterion. This criterion is routinely exceeded in urban creeks during storm events and in Sacramento and Feather Rivers following storm events during the dormant spray period. A TMDL is in progress to address these issues.

The Regional Board's strategy for agricultural sources of OP pesticides is to allow the local stakeholders an opportunity to identify management measures that will reduce the levels of pesticide runoff to acceptable levels while maintaining agricultural productivity. The Sacramento River Watershed Program, dedicated to working on watershed issues within this area, formed the OP Pesticide Focus Group (Focus Group), a stakeholder group representing a wide variety of interests (including pesticide manufacturers, agricultural groups, regulatory agencies, the City of Sacramento and academia), to address OP pesticide runoff to the Sacramento and Feather Rivers from orchards during the dormant spray season. The Focus Group has developed a strategy that should help with the implementation of the diazinon TMDL for the Sacramento and Feather Rivers. It is hoped that aspects of the strategy will also be applicable to other areas of the Central Valley. Specifically, the strategy will include a menu of management measures with estimates of the effectiveness of the management measure in reducing pesticide loads, identification of data gaps relative to management measure effectiveness in reducing OP pesticide loads, and an education and outreach program to encourage participation from growers and pesticide applicators. Additional benefits may be expected from these practices: some of the application method practices could serve to mitigate other sources of pesticide loading, and many of the on-site practices can be effective in reducing nutrient and sediment loading to the watershed.

Many growers are using alternatives to OP pesticides, specifically, pyrethroids. Unfortunately, pyrethroids, while insoluble in water, are highly toxic to aquatic organisms and can enter water bodies bound to sediment particles. Funding is needed to study this alternative pesticide and identify potential environmental impacts.

Urban Runoff: Urban runoff consistently causes acute toxicity to *Ceriodaphnia* in Sacramento area urban creeks and infrequently causes toxicity in both the Sacramento and American Rivers. Toxic conditions can be expected in other urban areas in the watershed. Toxicity to *Ceriodaphnia* has been linked to the insecticides diazinon and chlorpyrifos. Malathion has also been detected at concentrations exceeding the US EPA

water quality criterion. A number of Sacramento urban creeks are included on the 303(d) list as impaired due to malathion.

The Urban Pesticide Committee (UPC), with representatives from the Central Valley and San Francisco Regional Boards, municipal storm water agencies, sanitation districts, the Department of Pesticide Regulation, US EPA, pesticide registrants, pesticide control operators, county agricultural commissioners, and others, was formed by the Central Valley and the San Francisco Regional Board staff to address the issue of OP pesticide toxicity in urban creeks. The Regional Boards' strategy is to use the UPC as a communication point in the many urban creek OP pesticide TMDLs that must be developed in the Central Valley and San Francisco Bay Area. In this capacity, the UPC could be instrumental in communicating the various tasks required in developing these TMDLs.

NPDES: Pesticides are included in laboratory screening done once every five years as part of the NPDES renewal process. If pesticides are found at levels of concern, monitoring and effluent limits may be prescribed as is appropriate.

Organochlorine Pesticides

The Sacramento River has elevated concentrations of organochlorine compounds, including PCBs, DDT and its metabolites DDD and DDE, toxaphene, and chlordane. The pesticides in the Sacramento River are thought to result primarily from past agricultural use since use of chlordane, DDT, and toxaphene has been banned.

The Basin Plan prohibits detectable concentrations of persistent organochlorine pesticides in receiving water. NPDES monitoring for some municipal wastewater facilities is showing the presence of lindane in the effluent. Because these municipal discharges are to effluent dominated water bodies where the receiving water limit is applied to the effluent, the presence of lindane indicates a violation of the basin plan objective.

Metals

Mercury: Mercury in the Sacramento River is generally the result of past mining activities in the Coast Range and the Sierra Nevada Range. There are numerous mercury mines in the Coast range and mercury was used in the Sierra gold mining operations. Several studies have focused on determining mercury load estimates from the Sacramento River watershed. From May through December 1994 (low flow) an estimated 20 kilograms (kg) of mercury entered the Delta from the Sacramento River. From January through April 1995 (high flow) 406 kg of mercury entered the Delta from the Sacramento River. A loading study conducted by Larry Walker and Associates (1997) estimated that 640 kg of mercury were exported by the Sacramento River watershed to the Delta from October 1994 to September 1995. Most of the material was contributed during winter high flow periods. The Feather and American River watersheds accounted for approximately 25 percent of the load; the majority of the mercury appeared to originate from the Sacramento River watershed above the

confluence of the Feather River. The bioavailability of these sources of mercury is unknown. Fish tissue studies are needed in Sierra Nevada reservoirs and Coast Range reservoirs where the levels of mercury may warrant consumer advisories.

NPDES permits for surface water dischargers contain concentration and load limits for mercury, monitoring requirements and pollution prevention plans. In addition, major municipal dischargers are required to lower mercury discharges through pretreatment activities.

The Sacramento River Watershed Program formed the Delta Tributaries Mercury Council to address the mercury issues. The goals of the Delta Tributaries Mercury Council are to provide technical assistance in developing site-specific criteria, standards or other targets for mercury, develop conceptual model(s) to describe fate, transport, sources, and processes affecting ambient levels of mercury, help identify and quantify important point and non-point sources of total and methyl mercury, and help implement monitoring to evaluate effectiveness in reducing mercury loads.

Urban Storm Runoff: Urban runoff is known to contribute to metal loads in the watershed. Storm water permits include provisions to address the urban runoff contribution of mercury to the impairment of the Sacramento River.

Other metals

Urban Runoff: Urban runoff is a major source of lead. The Sacramento Stormwater Program estimates an annual load of 5000 pounds of lead is contributed from the Sacramento urban area. Copper, zinc, and nickel in urban runoff have been linked to observed toxicity in urban runoff. Storm water permits include a provision to develop a Storm Water Quality Improvement Program to address storm water pollutants that cause or contribute to exceedances of water quality standards and potential impairment of beneficial uses.

Acid Mine Drainage: In the past fifteen years, numerous mine abatement projects have been implemented in the upper Sacramento River watershed. The largest of these projects, Iron Mountain Mine, was listed as a Federal Superfund Site since 1983 and remediation efforts have been underway since 1988. Currently, most of the acid mine drainage from the Iron Mountain Mine site is collected and treated (lime neutralization treatment).

Acid mine discharge control efforts at the Shasta Lake mines have focused on reducing water drainage into the mines and installing concrete bulkhead seals on mine adits. This activity has had partial success and overall, has reduced metal loading to tributary streams to Shasta Lake. The Regional Board adopted additional enforcement orders on the Redding area inactive mines and abatement efforts are continuing.

State and Regional program policy, legislative reform (to address liability issues), and public funding for abatement projects are key elements in the Regional Board's efforts to

address the issue of metal discharge from abandoned mines. Staff is working with other stakeholders to understand the metal issues in the watershed.

Toxicity

Toxicity to *Ceriodaphnia* and *Selenastrum* has been detected in the Sacramento, Feather and American Rivers. Diuron has been identified as the cause of algal toxicity observed in the Sacramento River, San Joaquin River and the Delta. The majority of diuron applications in 2000 was to right-of-ways and alfalfa crops. Additional algal toxicity has been found but has not been linked to a specific chemical.

In 1997, Regional Board staff conducted a toxicity survey of the Sacramento River watershed using rainbow trout embryos. Significant mortality occurred in urban runoff-dominated creeks during the early portion of the storm season. The cause of this toxicity is unknown. Calfed has provided funds for a study to begin in Spring 2003 with trout embryos to try to determine the cause of the toxicity.

Sedimentation

Many tributaries in the watershed are adversely impacted by land use practices that cause excessive erosion and sedimentation, change flow regimes, or alter stream morphology. Degradation of upstream watersheds can also impact downstream beneficial uses (i.e., decreasing reservoir life, silting in spawning beds, etc.). Many of the tributary watersheds have active stewardship and conservancy groups, which have identified sedimentation as the major water quality problem in many areas. The sources of the sediment include stream bank erosion, erosion following fires, erosion associated with timber harvest activities, road construction, cattle grazing, and urban construction activities.

The Regional Board strategy to address sedimentation is to assist local watershed groups to develop citizen-based programs to reduce impacts of erosion and stream sedimentation. Goals of these programs include: teaching citizen volunteers to use a variety of assessment tools to collect data about watershed conditions and evaluate effectiveness of outreach efforts; educating stakeholders about land use activities which increase erosion and sedimentation; implementing best management practices to reduce sediment loading and to maintain stream channel integrity; and implementing demonstration restoration projects. Regional Board participation in these projects is funded with limited resources from the nonpoint source program and the Surface Water Ambient Monitoring Program (see "Monitoring and Assessment" in the Regionwide Activities section for more information on this program). However, funding is not adequate for staff to fully participate in all the projects taking place in this watershed.

Temperature

The major reservoirs in the watershed change the flow regimes in the downstream rivers. One of the consequences is change in downstream temperature.

Elevated temperatures pose a threat to salmon and steelhead, and are a concern in Mill, Deer, Battle, Butte, Antelope, Clear, and Big Chico Creeks. The Department of Fish and Game has recommended that the Basin Plan objectives be amended to protect salmon runs in these streams. Temperature increases are associated with loss of riparian habitat and agricultural and urban run-off.

No resources are available to work on temperature issues except for watershed assistance funded through the nonpoint source program.

Polychlorinated Biphenyls (PCBs)

Total PCB concentrations are above EPA recommended criteria to protect human health at the confluence of the Sacramento and San Joaquin Rivers in the Delta. In addition, clam transplant studies demonstrated that some of the highest tissue concentrations were obtained from animals located in the Sacramento and San Joaquin Rivers. The data were interpreted to mean that the Rivers were a source of PCBs. Additional monitoring resources are needed to determine the importance of riverine loads and the temporal and spatial extent of exceedances in the Sacramento River, as well as resources to develop guidance on how to design and analyze studies for determining whether or not fish tissue levels of contaminants are elevated.

Watershed Stewardship Programs

In addition to the Sacramento River Watershed Program, there are numerous local, grass roots efforts that have been initiated to restore watersheds that have been degraded, or are threatened to be degraded by various land use practices. Restoration efforts include stream rehabilitation, changes to existing land use practices, and improved watershed management (i.e., forest management, wildfire fuel reduction). Regional Board staff is currently working with several local watershed groups with overall objectives of improving water quality and aquatic habitat conditions. Staff will continue to assist with monitoring and assessment efforts to identify problems and document watershed problems, seek funding support for grants and attend meetings. In the Sacramento River watershed, staff is working with local groups on Mill Creek (Tehama County), Big Chico Creek (Butte County), Butte Creek (Butte County), Deer Creek (Tehama County), Goose Lake Basin (Modoc County), Clear Creek (Shasta County), Fall River (Shasta County), Stony Creek (Glenn County), the North and Middle Fork American River (Placer County), Putah Creek (Yolo County), Yuba River (Nevada County) Dry Creek (Sacramento and Placer Counties), Auburn Ravine (Placer County), and the Sacramento Urban Creeks Council (Sacramento County).

Several local programs are implementing monitoring programs being conducted by community volunteers. These programs focus on biological and habitat assessments, toxicity testing and evaluation of the impacts of various land use practices. This monitoring provides useful information and increases community awareness for the need for local stewardship. However, these programs are grossly under funded.

The following is a discussion of the NPS problems and issues for specific sub-watersheds (also, separate reports are attached for the Pit River, Feather River, and the Cache Creek sub-watersheds).

McCloud River Sub-Watershed

The McCloud River originates in the Cascade Range east of Mount Shasta and flows approximately 20 miles to its confluence with Lake Shasta. McCloud Reservoir was constructed in 1965 in the upper portion of the watershed to augment the PG&E McCloud-Pit Hydroelectric Project. The McCloud River remains, for the most part, a pristine watershed. Notwithstanding, there is concern about the possible impacts of McCloud Reservoir on sediment transport, water temperature and flow regime. Studies are needed to document existing conditions and identify potential problems.

Upper Sacramento River Sub-Watershed

This sub-watershed area includes the Sacramento River and tributaries from its headwaters downstream to Lake Shasta (including Lake Siskiyou). Water quality is generally good and no specific problems have been identified. Potential problems are from erosion and sediment discharge from logging, road construction and other land disturbing activities, urban storm water discharge from the Dunsmuir and Mt. Shasta City areas, future spill events from the Sacramento River canyon transportation corridor, municipal waste discharges from unsewered areas, and temperature increases in the lower reach to the River. Studies are needed to document existing water quality conditions and evaluate these potential problems.

Lake Shasta Sub-Watershed

This sub-watershed includes Lake Shasta, Keswick Reservoir and tributaries thereto. The principal water quality issue is acid mine drainage from abandoned and inactive copper mines that operated in the early 1900s. Several streams tributary to Shasta and Keswick Reservoirs are severely impacted by continuing discharges of acid mine drainage and are currently on the 303d list for contamination from acid and heavy metals. These include Spring Creek, Squaw Creek, Little Backbone Creek, Horse Creek and Town Creek. Portions of Shasta and Keswick Reservoirs have poor water quality and periodic fish kills where these tributaries enter the lakes. There is some concern with bacteria concentrations from high-density recreational use in Shasta Lake but no specific problems have been identified.

Clear Creek. Sub-Watershed

This sub-watershedincludes upper Clear Creek (above Whiskeytown Reservoir), Whiskeytown Reservoir, lower Clear Creek (below Whiskeytown) and tributaries thereto.

Willow Creek (tributary to Clear Creek) is on the 303d list due to acid mine drainage from Greenhorn Mine (inactive copper mine). Whiskeytown Reservoir is on the 303(d) list due to past studies that found elevated bacteria concentrations from high density recreational use. There is a general concern with erosion and sediment discharges

throughout the watershed, and with storm water runoff from the urban area in the lowermost reach of Clear Creek.

Sacramento River (Shasta Dam to Hamilton City)
This portion of the Sacramento River is important for spawning and propagation of salmon, steelhead and a resident trout fishery, provides municipal supply water for Redding and surrounding communities, and is a high use recreational area. Abandoned/inactive mines in the Redding and Shasta Lake area have historically impacted water quality and aquatic life in the Sacramento River and its tributaries. Studies conducted before 1994 showed algal and invertebrate toxicity in the Sacramento River linked to copper and zinc. In recent years (post-1994), remediation efforts at Iron Mountain Mine and other inactive mines have resulted in a substantial reduction in metal loading to the Sacramento River. Sampling conducted since February 1995 suggests that Basin Plan objectives for copper, cadmium, and zinc in the upper Sacramento River have been rarely exceeded. Recent toxicity tests have not detected toxicity below Keswick Reservoir. Remediation efforts are continuing to address the residual loading of acid mine drainage from these mines.

Other potential problems in this sub-watershed include storm water discharge from the Redding urbanized area, erosion and sediment discharges from land disturbing activities, and high turbidity from water releases through Shasta Dam.

Further downstream there is some indication of elevated mercury concentrations in the River reach below Red Bluff. The extent of mercury loading and the source has not been documented but a likely source would be the high sediment load from the Westside tributaries.

North Sacramento River Basin Tributaries
The principal sub-watersheds here include Churn Creek, Stillwater Creek, Cow Creek, Bear Creek, and smaller drainages within the Redding urban area.

While there are no specifically identified water quality and beneficial use problems, potential problems exist from municipal and industrial storm water discharges, from erosion and sediment discharges from construction and other land disturbing activities, and from bacteria contamination of those waters commonly used for contact recreation. These watercourses currently support or have potential to support anadromous fish populations so protection of aquatic habitat is also an important issue.

Westside Sacramento River Tributaries
The principal sub-watersheds here include Cottonwood Creek, Reeds Creek, Redbank Creek, Elder Creek and Thomes Creek.

Tributary watersheds on the Westside of the Sacramento River have relatively high erosion and sediment yields resulting from a combination of unstable geology and past and ongoing land use practices, including urbanization, livestock grazing, road construction, gravel mining, agriculture and wildfires. While no specific water quality

and beneficial use problems have been identified, it is believed that these high sediment yields and the channel instability conditions are adversely impacting water quality and aquatic habitat throughout most of these watersheds. The overall objective here is to increase water retention capacity to reduce peak flows and increase base flows, increase the quality and diversity of aquatic life and riparian habitat, and reduce total sediment load to the Sacramento River.

Eastside Sacramento River Tributaries

The principal sub-watersheds here include Battle Creek, Antelope Creek, Mill Creek, Deer Creek, Big Chico Creek, and upper Butte Creek.

These streams represent some of the State's largest undammed watersheds and provide valuable habitat for anadromous fish particularly spring-run salmon and steelhead. Water quality conditions are generally good, however, there are potential problems with low summer flow, high water temperatures, erosion/sediment discharge, municipal and industrial storm water discharge from the urbanized area of Chico, and geothermal sources of mercury in Mill Creek. Some reaches in the upper portions of these watersheds show evidence of channel instability and degraded aquatic habitat, principally from past and ongoing livestock grazing practices. Overall, the objective is to protect the existing high quality of these watersheds and implement site-specific projects that reduce erosion/sedimentation and improve aquatic habitat.

Upper Feather River Sub-Watershed

This River sub-watershed covers 3,222 square miles from the crest of the Sierra Nevada downstream to Lake Oroville. Past and ongoing land management practices have increased stream channel instability and incisement leading to accelerated erosion/sediment discharge, increased water temperature and other adverse impacts on water quality, fisheries and aquatic habitat. These land management practices include mining, livestock grazing, wildfire, timber harvest, and railroad and highway construction and maintenance.

American River Sub-Watershed

This sub-watershed consists of approximately 1,900 square miles on the western slope of the Sierra Nevada Mountains, extending from the spine of the Sierra Nevada westward to the City of Sacramento. The sub-watershed is bordered by the crest of the Sierra Nevada and the Lake Tahoe Basin on the east, the Yuba and Bear River sub-watersheds on the North, the South Fork of the American River sub-watershed on the South, and Folsom Lake on the west. The drainage of this sub-watershed exceeds 1,100,000 acres.

Historical land uses include mining, recreation, grazing, logging, and water diversion. Long term forest health and catastrophic wildland fires are of critical concern as are erosion and sedimentation, habitat quality, habitat disruption and depletion of biodiversity, the intermix of rural homes and resultant economic fire hazards, the need to maintain the area's economic stability, the need to maintain the stability of the sub-watershed, and the critical need for high quality waters throughout the American River sub-watershed to serve multiple and highly varied downstream needs.

The Lower American River is on the 303(d) list due to pesticide and mercury concentrations in fish tissue. Isolated water quality problems are associated with urban runoff and sewage discharges in the foothills. Septic systems are of concern because of their large number in the upper watershed and, due to a lack of resources for monitoring; there is little assurance that they have been maintained.

Lower Sacramento and Feather River Sub-Watersheds

Water quality in the Lower Sacramento River is being addressed by several major programs and legislative mandates. Regional Board staff will act as liaison and will coordinate with these programs and the agencies implementing them.

Monitoring and Assessment (Surface Water Ambient Monitoring Program)

The Sacramento River Watershed Program (SRWP) has an ongoing monitoring program so the strategy in this watershed is to use state monitoring funds to supplement the SRWP efforts.

Previous monitoring efforts in the Sacramento River watershed have focused on the Mainstem River and its major tributaries. Future monitoring priorities should concentrate on wadable streams tributary to the Sacramento River, establishing baseline conditions, and determining indicators that can be tracked as watershed improvement projects are implemented. Staff is working with the Sacramento River Watershed Program to design and implement a monitoring program to assess pollutants throughout the watershed.

GROUND WATER

Nitrates

There are roughly 300 square miles of ground water in the watershed with elevated levels of nitrates. The primary areas of concern are in the vicinity of Chico, much of Sutter County, and the Antelope area in Tehama County. The Antelope area of Tehama County is part of the City of Red Bluff, but is currently without sewers. The total size of the area is approximately 3 square miles, with a population of about 3,000 residents. The Chico area is comprised of approximately 25 square miles, with an unsewered population of approximately 38,000. Less severe impacts are found in the vicinity of Knights Landing, Arbuckle, Yuba City, and Willows. Many counties in the watershed depend extensively on septic systems for household wastewater treatment. For example, Butte County with a population of slightly over 200,000, relies on septic systems for approximately 150,000 of its citizens. Not only do septic systems contribute to contamination of ground water, but improperly located and designed, constructed or maintained systems, represent a significant threat to surface water. Nitrates are also a major concern at confined animal facilities, either through inadequate liners in storage ponds to contain wastes, or over-application of wastes on cropland, with the resultant leaching of nitrate and salts to groundwater.

Strategies to Address Nitrates

In order to control nitrates, the Board adopted a septic tank prohibition for the Chico Urban Area to take effect by the end of 1996. The current Regional Board Guidelines for Waste Disposal from Land Developments minimizes, although it does not prevent, development densities that may cause ground water nitrate impacts. These Guidelines need to be updated to prevent problems from occurring. The State Water Board has been required under Section 13291 of the California Water Code to adopt regulations or standards for the permitting and operation of onsite sewage treatment systems by 1 January 2004. The State Water Board has formed advisory groups to help develop these regulations. Regional Water Board staff is participating in the advisory groups.

There are other sources of nitrates in the watershed. Irrigated agriculture and animal confinement facilities contribute nitrate loads to ground water. The Regional Board maintains a baseline dairy regulatory program, which partially addresses this source of nitrates. There is no program to evaluate or address impacts to groundwater from irrigated agricultural activities.